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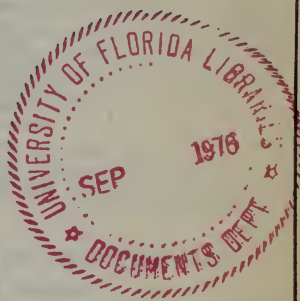
ORGANIZATION AND MANAGEMENT
OF EPA'S
OFFICE OF RESEARCH AND DEVELOPMENT

PREPARED BY THE
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LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, D.C., June 30, 1976.

HON. OLIN E. TEAGUE,
Chairman, Committee on Science and Technology, U.S. House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: In the exercise of its oversight responsibilities, the Subcommittee on the Environment and the Atmosphere has held extensive hearings on the organization and management of the Office of Research and Development of the Environmental Protection Agency. A major reorganization of that Office was announced about one year ago, and the reasons for, and results of, that reorganization have been reviewed in detail during both authorization and oversight hearings, as well as visits to EPA laboratories.

I am transmitting herewith a report which summarizes the organization and management deficiencies of the past, assesses the efficacy of the reorganization, and includes findings and conclusions on the major issues bearing upon the vital work of EPA's Office of Research and Development as perceived by the Subcommittee.

Sincerely,

GEORGE E. BROWN, Jr.,
*Chairman, Subcommittee on the
Environment and the Atmosphere.*

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INTRODUCTION

The National Environmental Policy Act (NEPA), P.L. 91-196 which was signed into law on January 1, 1970, established a national policy of encouraging productive and enjoyable harmony between man and his environment, promoting efforts to prevent or eliminate damage to the environment, enriching the understanding of the ecological systems and natural resources important to the nation, and requiring all Federal agencies to consider the environmental consequences of their activities.

Following this statement of national policy, a Presidential commission, known as the ASH Council, noted the dispersion of authority for environmental regulation among a large number of Federal agencies, and recommended establishment of a new agency with broad regulatory powers. In December 1970, under the terms of Executive Reorganization Plan #3, the Environmental Protection Agency (EPA) came into existence to consolidate the functions and responsibilities of 15 separate organizational units scattered around the Federal government, and was given the mandate to respond to the nation's environmental problems.

The ASH Council recommended establishment of a research arm in the new agency, and the research components of the 15 separate organizations brought together to form EPA were therefore combined to form the Office of Research and Monitoring, which was later renamed the Office of Research and Development.

The 42 separate field installations which made up the Office of Research and Monitoring had been conducting research in areas including air and water pollution, solid waste management, pesticides, and radiation. According to Dr. Wilson K. Talley, EPA's Assistant Administrator for Research and Development, each group of installations had a distinct and different type of management ranging from Washington-managed laboratories to quasi-independent, extramural-oriented field operations. Dr. Gordon MacDonald, a former member of the Council on Environmental Quality, observed that the varied character and wide geographical distribution of the various research laboratories and field stations made management problems particularly severe.

In the initial organization, the number of separate research units was reduced through consolidation of activities, and three large field units (National Environmental Research Centers, or NERCs) were created. Two of these, in Research Triangle Park, North Carolina and Cincinnati, Ohio, consisted of an administrative office and a series of laboratories; the third, in Corvallis, Oregon, had laboratories reporting to it from locations across the United States. Later, a fourth NERC was created in Las Vegas, Nevada all of whose components were local. Each of these NERCs was given a "theme," or program area, in which to concentrate. Some groups were geographically relocated to consolidate the themes of each NERC, but the movement of pro-

grams and people was never completed. As a result, the thematic specialization of the NERCs was never fully implemented, and the laboratories associated with each NERC continued to be involved in a wide range of environmental research and development activities.

Molding the activities of such a conglomeration of geographically dispersed laboratories and personnel with their different orientations, varied mix of skills, and different *modus operandi* into a coherent and cohesive research effort posed extraordinary obstacles for top management. The response of the first Assistant Administrator for Research, Dr. Stanley Greenfield, was to establish a highly centralized Washington-based system.

With the passage of time, it became clear that severe management problems existed in the Office of Research and Development, and several studies, some internal to EPA and others external, were undertaken. Highly critical reports were issued in 1974 which culminated in a major reorganization of the Office in 1975 under new management.

COMMITTEE INTEREST

As a consequence of a major revision of the Rules of the House of Representatives which took effect at the beginning of the 94th Congress in January 1975, the Committee on Science and Technology acquired jurisdiction over, among other things, environmental research and development.

The Subcommittee structure was revised to reflect the newly acquired jurisdiction of the full Committee, and a new Subcommittee on the Environment and the Atmosphere was established.

The several critical reports on the organization and management of EPA's Office of Research and Development lent emphasis to the need for the Subcommittee to exercise substantial legislative oversight of the accomplishments, plans, and goals of EPA's research program as a whole through the annual authorization process, a comprehensive review that had been impossible previously due to the fact that jurisdiction over various aspects of the program had been divided among three Committees of the House of Representatives and four Senate Committees.

During the initial R&D authorization hearings in March 1975, EPA's newly appointed Assistant Administrator for Research and Development, Dr. Wilson K. Talley, testified to the effect that he had undertaken a thorough study of the organizational structure, program management, planning and conduct of research by his office in light of the several critical reports that had been issued during the previous year or so. He stated he had personally visited 23 of ORD's field units since taking office some four months earlier, and had talked to more than 300 ORD personnel.

During his testimony before the Subcommittee, Dr. Talley provided the general outlines of the major reorganization of ORD which he had in mind. Washington headquarters henceforth would focus on long-range, objective-oriented planning and broad-scope program review and oversight; greater resource management and program implementation responsibilities would be delegated to ORD's network of field laboratories; the mission of the ORD laboratories would be clarified; and the planning and management system would be simplified.

The promised reorganization was announced some three months later in June 1975.

In December, 1975, after the ORD reorganization had been in place for about six months, the Subcommittee scheduled five days of hearings in order to provide Dr. Talley an opportunity to describe the nature and purposes of his reforms, and to make a preliminary assessment of the effectiveness of the reorganization.

The following witnesses, in the order of their appearance, were heard:

Dr. Wilson Talley, Assistant Administrator for Research and Development, Environmental Protection Agency, accompanied by

Dwight Ballinger, Director, Environmental Monitoring and Support Laboratory, Cincinnati; Delbert S. Barth, Acting Director, Environmental Monitoring and Support Laboratory, Las Vegas; Thomas Duke, Acting Director, Environmental Research Laboratory, Gulf Breeze, Fla.; John H. Knelson, Director, Health Effects Research Laboratory, Research Triangle Park, N.C.

Dr. Gordon J. F. MacDonald, Henry B. Luce Chair of Environmental Studies and Policy, Dartmouth College.

Dr. John Neuhold, Director, Institute of Ecology, and Professor, Utah State University.

Dr. Roy E. Albert, Deputy Assistant Administrator for Health and Ecological Effects, Office of R. & D., EPA.

Dr. Stephen J. Gage, Deputy Assistant Administrator for Energy, Minerals & Industry, Office of R. & D., EPA.

Dr. Thomas A. Murphy, Deputy Assistant Administrator, Office of Air, Land, and Water Use, Office of R. & D. EPA.

Mr. Albert C. Trakowski, Deputy Assistant Administrator for Monitoring and Technical Support, Office of R. & D., EPA.

Vaun A. Newill, M.D., Director, Environmental Health Research and Health Division, Exxon Corp.

Dr. Milton Harris, former Vice President for Research and Development, Gillette Co.

Dr. Emil Mrak, Chancellor Emeritus, University of California, Davis, Calif.

Dr. John Tukey, Bell Telephone Laboratories, Linden, N.J.

ORGANIZATION AND MANAGEMENT CHANGES

The major deficiencies noted in the various critical reports on EPA's Office of Research and Development can be summarized as follows:

(1) The Office of Research and Development had become tangled up in an elaborate planning system that created a lot of paper, and which developed into a cumbersome management tool. This detail-intensive planning system was based upon a "vacuum-cleaner" approach to the solicitation of ideas from the field without an effective method of establishing priorities, and it was unrelated to an overall strategy. As the report of the National Academy of Sciences found, the "large amount of paperwork and excessive bureaucratic review (constituted) a wasteful consumption of time and energy."

(2) Authority to manage the financial and other resources of the Office of Research and Development was not clearly delegated, and lines of authority and responsibility between headquarters and the field were confused. Several groups at headquarters level provided program direction and resource allocation to the laboratories. NERC Directors were sometimes by-passed. Timely, responsive research was thereby impeded, and morale was adversely affected. "Accountability (was) made impossible by the parallel but separate management systems—some for housekeeping and the others for program content—and by the hopelessly complex . . . system which obfuscates management responsibility," according to the report of the National Academy of Sciences.

(3) Headquarters staff had become too large and too much involved in the details of research done in the laboratories. Instead of establishing broad goals and an overall research strategy, headquarters had developed a management system based upon the detail-intensive planning system.

If ever anyone had a mandate to change the structure and management of an organization, the newly appointed Assistant Administrator for Research and Development, Dr. Wilson K. Talley, had such a mandate.

Dr. Talley took office late in 1974, after the position had remained open for some six months. He immediately undertook a detailed review of the organization, and about six months after taking office he announced a comprehensive reorganization of the Office of Research and Development. His stated goals were to be accomplished within the following constraints: there should be an absolute minimum of disruption of the ongoing research and development programs; geographic displacement of individuals should be kept to a minimum; and clear lines of authority and responsibility should be established. Working groups, consisting of individuals from headquarters, the NERCs, and the laboratories, were established to analyze and make recommendations regarding both program and management structure.

Under the reorganization, the programs and management of the Office of Research and Development were completely restructured.

It was decided that ORD's activities should be organized in such a way as to group the research programs according to problems being addressed and to type of output needed. Consequently, ORD's short-term activities, including analytic responses to the needs of the Agency's regulatory and enforcement offices, were grouped together under the heading of monitoring and technical support. While specific problems cannot always be foreseen, Dr. Talley states that a level of effort for work of this type can be anticipated and planned for based on historical information.

The relatively longer-term research activities relating to the determination of the human and ecological effects of pollutants sometimes require several years in order to obtain the necessary results, and consequently must be supported with a relatively stable level of resources. Dr. Talley has organized these activities into a health and ecological effects program.

The third component of ORD's mission, designed to meet legislative and Agency mandates for control or abatement technology, was, because of its size, organized into two groups. The first group—energy, minerals, and industry—focuses on point, or basically industrial, sources; while the second—air, land, and water use—includes work in the nonpoint source and public sector areas. The latter program also includes research on the transformation and physical transport of pollutants in the environment.

These four new groups—monitoring and technical support; health and ecological effects; energy, minerals, and industry; and air, land, and water use—have been placed under the direction of four new Deputy Assistant Administrators at Washington Headquarters.

The National Environmental Research Centers were abolished under the reorganization, and their functions and personnel were transferred to the laboratories.

The laboratories were consolidated, based upon mission and geographic proximity, from 24 units to 15, and the work of each laboratory is concentrated in one of the four new research areas.

Program regrouping was designed to give each of the resulting 15 laboratories a clear focus for its mission. Most of these laboratories accomplish their mission with a mixture of in-house and extramural research. However, according to Dr. Talley, a few do all their work by contract and grant and are therefore research managers; and a few others accomplish their missions essentially with in-house staff.

In addition to the new organizational structure, Dr. Talley established several new management concepts which included defining the responsibilities of Washington headquarters and the 15 field laboratories in such a way as to create a single line of authority between them. This required a major reorientation of headquarters staff.

Headquarters staff have been removed from the day-to-day management of the on-going research program and given responsibility for longer range program planning; for coordination within the Agency and with other Government and industrial groups; and for review and integration of the laboratories' outputs.

Under the new management scheme, the laboratories are now charged with detailed program planning and implementation. Each laboratory relates through a clear and accountable direct line authority to a specific Deputy Assistant Administrator (DAA), who directs both headquarters and laboratory efforts in one of the four major

program offices. The DAA's, along with the Assistant Administrator, the Associate Assistant Administrator, and the Directors of two support offices (the Office of Financial and Administrative Services, and the Office of Planning and Review) make up the senior staff group which serves as the top level management at Washington headquarters.

Dr. Talley notes that central to any management system is how and who controls resources, both funds and personnel. Under his reorganization, resource control flows from Dr. Talley to the four Deputy Assistant Administrators, and from them to the laboratory directors under their supervision. Consequently, says Dr. Talley, those who have the responsibility for carrying out ORD's programs now have clear control of the resources which are available for these programs.

IMPACTS OF REORGANIZATION

The majority of the witnesses before the Subcommittee tended to view the reorganization of the Office of Research and Development in a favorable light both in terms of simplifying the planning and management system, and establishing clearer lines of authority and accountability.

Despite Dr. Talley's stated goal of minimizing the adverse effects on employees of the Office of Research and Development, some disruption inevitably has occurred. Overall, 39 employees have been relocated to other geographical sites. In an organization employing some 1800 personnel, however, relocation of so few people appears to be minimal. According to Dr. Talley, 10 proposed geographic relocations of personnel were decided against because undue hardships would have been imposed on the individuals involved.

Geographic relocation is only one factor bearing upon morale of personnel. A more nebulous impact, says Dr. Talley, but perhaps a more serious one, is the concern felt by a number of individuals over changes in the type of work they are doing and their responsibilities. Chiefly affected were headquarters professional personnel and senior laboratory personnel. Because Dr. Talley's purpose was to do more long-term program planning and coordination at headquarters, as well as to undertake periodic reviews, the headquarters staff is now expected to handle broader, policy-related matters. Headquarters personnel who preferred to continue to manage research on a day-to-day basis, or to implement research programs, were given an opportunity to transfer to a laboratory, and 20 elected to do so. However, some who did not wish to relocate to the field reportedly have found it difficult to work in the new mode at headquarters with its new and broader responsibilities. Headquarters staff has been reduced from more than 300 personnel to fewer than 250 under the reorganization.

The transfer of additional authority to the laboratories has placed new responsibilities on the senior laboratory staffs, particularly in the management area. Dr. Talley notes that:

As with any effort that involves possible changes in personnel and organizational relationships, the uncertainty created by not knowing how one will fit into the new structure impairs the morale of the staff. . . . Once it becomes clear how individuals will fit into the new structure, morale should not be a significant problem.

Under the circumstances of reorganization, it is natural for some people to perceive that their positions have improved, while others feel that their relative positions and status in the organization have declined.

As Deputy Assistant Administrator Roy Albert has observed;

Any reorganization is a disruptive thing. It is similar to surgery. It is traumatic and requires a recuperative period. It is not done for fun. It is done to produce a beneficial effect and let us hope this reorganization does have a beneficial effect.

Dr. Milton Harris, a member of the EPA Science Advisory Board concludes that:

Most of the changes that Dr. Talley has instituted have the potential, given time, for improving the management of EPA's research and development pro-

grams. This does not mean that there are not dislocations. This does not mean that there is not going to be a lot of unhappiness. This is absolutely impossible to avoid in such a situation.

One of the more dramatic features of the ORD reorganization was the abolition of the Washington Environmental Research Center (WERC). Under the previous organizational structure, the basic responsibility for ORD's socioeconomic work, which comprised about one-fourth to one-third of the Agency's total socioeconomic research effort, was conducted by WERC.

WERC combined both the program management and program implementation functions, in contrast to the normal separation of these functions in the rest of the organization. Its activities ranged across a wide spectrum, and, according to Dr. Talley, criticisms were frequently directed at it, both externally and from other EPA offices, to the effect that its program was too broad to be useful in policy determination.

Dr. Talley has stated that under the reorganization, several steps have been taken to insure not only that broad-scale research will be conducted, but that useful policy-related socioeconomic analysis will be performed in a time frame that will have an impact on decisions. He explained that:

Socioeconomic research has been decentralized to integrate this research into the technical research programs that address specific research problems so as to make the socioeconomic research more relevant to real-world problems. In addition to this research, the Office of Health and Ecological Effects is responsible for the area of methodology development, including benefits assessment. Also, a comprehensive environmental management research program, as well as technology assessment activities, are the responsibility of the Office of Air, Land, and Water Use. The Office of Energy, Minerals, and Industry conducts a series of integrated technology assessments dealing with the environmental and socioeconomic consequences of alternative energy technologies, fuels and systems. Finally, the Office of Monitoring and Technical Support is responsible for making operational large-scale environmental assessment models.

In order to determine future directions for the broader, more basic socioeconomic research, EPA has undertaken a review of Agency-wide socioeconomic research needs, and plans to assemble a group of experts in the socioeconomics of environmental policy. This group will evaluate both Agency needs for this type of research and current state-of-the-art for conducting such research so that a meaningful socioeconomic research program can be developed which will be responsive to the Agency's needs and mesh with ORD programs.

Dr. Talley claims that a large amount of the work assessing the economic impacts of EPA regulations is not done by ORD, but is undertaken elsewhere in the Agency, and has therefore not been affected in any way by ORD's reorganization. He notes that EPA devotes more than one hundred professional man-years per year to economic analysis activities involving all or a portion of the time of 150 people. EPA also devotes more than ten million dollars each year to contract studies by independent outside organizations on work related to the economic impacts of EPA's programs. These in-house and consultant studies examine the costs and effects on consumers, business establishments, industries, and the country's economy of each major standard or regulation that EPA promulgates. Inasmuch as this work is largely performed in EPA's program offices, and in the Office of Planning and Evaluation, Dr. Talley asserts that the total effort has not been affected to any great extent by the reorganization of ORD.

LEGISLATIVE AUTHORITY

The original intent behind the Reorganization Plan that established EPA was to provide an integrated and comprehensive approach to environmental protection. Yet several witnesses noted the lack of comprehensive legislation to support such a program. As Dr. Gordon MacDonald has observed, management of longer-term research is hampered because EPA has necessarily focused on separate media, (land, air, and water) and individual environmental threats, (pesticides, solid waste, noise, and radiation), which are subject to various laws passed at different times but are now to be administered together. According to Dr. MacDonald, these legislated bits and pieces are in direct opposition to the holistic view which is essential to effective environmental management. Dr. MacDonald cites as an example the regulation of the disposal of sludge from sewage treatment plants; it may be incinerated, put into a landfill or dumped into the ocean, each solution governed by separate laws and each having broad and largely unknown impacts on the environment as a whole. He concludes that the program and organization of EPA, derived from a non-coherent set of pollution control legislation, runs counter to the comprehensive systems of the environment in virtually every instance.

Dr. John Neuhold adds that the research thinking which preceded formation of EPA, and to some extent still persists in EPA today, was media-oriented to a large extent engendered by legislative authority written along media lines. In the environmental arena, Dr. Neuhold emphasized that a pollutant knows no boundaries and intermedia approaches become necessary.

The research program of the Environmental Protection Agency is carried out under the following statutory authority:

The Clean Air Act, as amended, Public Law 88-206, directs EPA to conduct research on the causes, effects, extent, and ways to control air pollution. The agency is charged with the duty of providing technical and financial assistance to State and local air pollution control agencies, and special investigations by EPA may be instituted at the request of State governments. Federal interagency cooperation is encouraged and EPA's own research is directed into specific areas, including health problems, fuel combustion, aircraft emissions, cost-benefit studies and control technology. Under the Clean Air Act, the toxicological (as well as other) effects of air pollutants constitute a major research focus¹.

The 1972 amendments to the Federal Water Pollution Control Act, Public Law 92-500, establish research programs for the prevention, reduction, and elimination of pollution in navigable waters of the United States. The agency is directed to establish, in cooperation with all pertinent Federal, State, and private parties, comprehensive local and national programs for water pollution control. Specifically, the agency must render technical advice, and conduct research, investigations, experiments, training, demonstrations, surveys, and studies;

establish advisory committees to evaluate research progress and proposals; establish a water quality surveillance system to monitor the quality of navigable waters, and initiate and promote studies measuring the social and economic costs and benefits of water pollution control activities. The Administrator is also required to investigate the harmful effects of pollutants on the health and welfare of persons. The Administrator must establish field laboratories and research facilities, make a comprehensive study of the pollution of the Great Lakes, and finance pilot treatment works programs. Problems of pollution by eutrophication, oil spill, pesticides in water, and thermal discharge must be investigated.

Under the Safe Drinking Water Act, Public Law 92-523, the Administrator may conduct research, studies, and demonstrations relating to the causes, diagnosis, treatment, control, and prevention of physical and mental diseases and other impairments of man resulting directly or indirectly from contaminants in water, or to the provision of a dependably safe supply of drinking water.

The Solid Waste Disposal Act, as amended, title II of Public Law 89-272, directs the Administrator to conduct and cooperate with research efforts relating to any adverse health and welfare effects of the release into the environment of material present in solid waste, and methods to eliminate such effects; the operation and financing of solid waste disposal programs; the reduction of the amount of such waste and unsalvageable materials; the development and application of new and improved methods of collecting and disposing of solid waste; processing and recovering materials and energy from solid waste; and the identification of solid waste components and potential materials and energy recoverable from such waste components.

Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, Public Law 92-516, the Administrator shall undertake research to carry out the purposes of the act, giving priority to the development of biologically integrated alternatives for pest control. The Administrator shall formulate a national plan for monitoring pesticides, and undertake activities in support of it.

The Administrator, under the Public Health Service Act, as amended, Public Law 78-410, has broad research powers to develop accurate estimates on levels of radiation in the environment, their pathways to man, and the health risks from these doses.

The Noise Control Act of 1972, Public Law 92-574, authorizes the Administrator to establish a comprehensive research program relating to noise. Such a program enables EPA to undertake the necessary investigations into the health effects of noise under varying conditions of magnitude, duration, background, etc.

The National Environmental Policy Act (NEPA) Public Law 91-190, requires Federal agencies to prepare environmental impact statements (EIS) for legislative proposals and for other "major federal actions that significantly affect the quality of the human environment." In preparing these EISs, a Federal agency must consult with other agencies having jurisdiction by law or special expertise over such environmental considerations. Since EPA's purview is the total environment, it must be consulted for most EISs.

Under the Marine Protection, Research and Sanctuaries Act, Public Law 92-532, the Administrator, in coordination with the Secretary of Commerce and the Coast Guard, shall initiate a comprehensive and continuing program of monitoring and research regarding the effects of the dumping of material into the ocean water or waters which ebb or flow into the Great Lakes and report the effects not less frequently than annually. The Administrator is responsible for offering consultation to the Secretary of Commerce on the possible long-range effects of pollution, overfishing and man-induced changes of ocean ecosystems.

Inasmuch as the statutory basis for the conduct of research is piecemeal and fragmentary, the Committee on Science and Technology hopes to assist in the achievement of a more balanced, integrated, and coherent research program by reviewing, on an annual basis, the accomplishments and goals of EPA's Office of Research and Development, using the vehicle of an annual authorization.

RESEARCH MODES

There is a wide divergence of informed opinion as to (1) the most effective mode for carrying out environmental research and development, (2) whether a regulatory agency should conduct its own R&D, and (3) whether it is possible to pursue a balanced R&D program without clearly distinguishing technical support of the regulatory and enforcement functions from longer-term basic research and, in some manner, insulating the financial and personnel resources of the latter from the exigencies of the former. Nor is there a consensus as to whether it makes sense to attempt any additional reorganization of EPA's research program in the foreseeable future.

Almost every type of research management scheme can be found somewhere in the Federal government. As Dr. Talley observes, this diversity is not surprising, as different programs have different needs and outputs, and, perhaps more to the point, the various programs have different histories. Each mode of operation can be shown to have been successful.

As Dr. Gordon Macdonald has observed:

The laboratory and field activities of the U.S. Geological Survey exemplify a successful research organization under civil service. Scientists in the Geological Survey are for the most part highly regarded by their peers, and results obtained by Survey investigators carry considerable weight in decisions involving management questions of mineral resources, for example.

Similar success can be achieved under a contract laboratory system such as that employed by the Energy Research and Development Agency. The relative bureaucratic freedom in such organizations as Oak Ridge, Brookhaven and Los Alamos has led to the recruitment of highly regarded scientific staffs whose accomplishments are internationally recognized.

A third mechanism which has worked well in providing for high quality research is the establishment of semiautonomous research institutes such as those in the National Institutes of Health complex. The creation of an elite research organization such as NIH creates numerous problems but on the whole the research results have been widely acclaimed.

A final model is that of the National Science Foundation which operates through contracts, national research facilities such as the National Center for Atmospheric Research, as well as performing its principal task of administering a diverse grants and contracts program.

Dr. Talley concludes that there is no ideal Federal Government research and development management model. In fact, he has determined that for purposes of supporting EPA's mission, the best course is to maintain and strengthen the original ORD model of a combination of in-house Civil Service laboratories, extramural grant and contract research, and interagency agreements.

A related question is whether a regulatory agency should be involved in the conduct of research at all, the alternative being complete separation of research from regulation by arranging for the performance of these functions in different agencies. There are several recent precedents for this approach. The National Institute for Occupational Safety and Health (NIOSH), an agency of the Department of Health, Education and Welfare, is responsible for conducting the research activities that support the regulatory functions of the Occupational Safety and Health Administration (OSHA) of the Department of Labor.

Moreover, after many years during which both research and regulation were carried out by the Atomic Energy Commission (AEC), a recent decision to separate the two functions led to the establishment of two distinct agencies, the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC).

As Dr. John Tukey has testified,

Over the past few decades, we have come to recognize the need for separation of the regulatory function from the promotional function. Responsibilities once in USDA are now in EPA, others once in AEC are now in the new Nuclear Regulatory Commission.

Combining the two functions in a single agency raises the question of bias in some minds. As the Office of Technology Assessment has noted,

When a regulatory agency conducts its own research to evaluate and support regulations that it must enforce, there is a danger that a strong regulatory orientation will permeate the research program. If this occurs, the efficiency, content, and quality of the research being performed may be seriously degraded. It is a matter of special concern when the research program is not only supposed to establish regulatory support data but also promote the development of basic science in the affected areas.

Another reason for separating research from regulation has to do with allocation of resources. During his testimony on atmospheric sulfates research on July 11, 1975, Dr. Talley's predecessor in EPA, Dr. Stanley Greenfield had this to say about the difficulties of reconciling the two functions under a single management and one overall budget.

Research in an operational agency is always a difficult and uncomfortable activity. This is primarily because in the yearly competition for funds the operational arm of the agency always views itself as carrying out a clearly defined near-term mandate within that budget period.

In contrast to this, the research function, with its more distant, less clear goals, is always viewed as an unnecessary drain on limited resources and in many ways a hindrance to the accomplishment of the "more important" agency functions. This conflict is even further amplified in an operational regulatory agency, where the political measurement of its effectiveness is very closely tied to the day-to-day public view of its enforcement activities. In this case, the research function is not only viewed as utilizing needed current resources in order to accomplish future goals, but in addition it is seen as being constantly in the position of posing uncertainties and constraints in the technical base which underlies the desired regulatory action. The result is a constant battle in which the research function is continuously put in the position of having to request sufficient time and resources to provide an information base that is adequate to permit defensible, rational regulatory activities. From the regulatory side of this conflict emerges a resentment of the need to "waste" funds on nonregulatory activities and a frustration over the inability of the research activity to provide the needed and required information on demand.

The accomplished compromise to these opposing viewpoints is a research function that is never sufficiently funded nor given adequate time to acquire the required knowledge and a regulatory function that never had adequate information to make the decisions on which it acts. I should hasten to add at this point that this condition is too often not the complete fault of the regulatory agency, but rather may be due to the fact that unreachable or unreasonable implementation dates are legislated in an understandable attempt to produce quick positive results. While laudatory in intent, such action tends always to produce a chaotic response, and frequently can result in a counterproductive effort.

This conflict that classically exists between research and regulation, or research and any operational activity, was experienced by me during my entire tenure as Director of Research and Development for the Environmental Protection Agency.

A third reason for separating research from regulation is that it is difficult, some think impossible, for the research arm of a regulatory agency to undertake patient, uninterrupted long-term basic research—the type of activity that is characterized by stability and continuity.

EPA's research program has tended to be driven by urgent needs percolating up from the EPA regions which reflect the exigencies of the regulatory and enforcement functions of the agency. ORD's reaction has been described as "firefighting" and has led to the "pollutant of the month" syndrome which characterizes much of ORD's research. Dr. Talley makes it quite clear that he accepts ORD's support role for the rest of the agency, and he comes close to saying that relatively unfocussed basic environmental research of the type recommended by others is not a realistic goal for his organization. He claims that,

First and foremost is the full recognition that research serves a support function within the regulatory Agency. Our strategy, specific objectives and priorities should not and cannot stand as entities in and of themselves. Rather, they must derive from those of the Agency in the accomplishment of its total legislative mandate.

The program, then, is one of mission-oriented research and not one of so-called basic research. This is not to say that some very fundamental research is not, in fact, an integral part of our program. It is and must continue to be so because of our responsibility to provide the best scientific data and to develop control systems for pollution problems that are beyond the present state-of-the-art. Further, a most important research function is to anticipate the problems that will emerge in the future and—if we cannot prevent them—tag them so that they will not arrive unhearaled.

It its review of ORD's initial publication of its five year research plan, the Office of Technology Assessment (OTA) was rather critical of Dr. Talley's approach to basic research. It found that as an organization, EPA's Office of Research and Development (ORD):

Lacks a clearly defined commitment to research addressing long-range environmental concerns; it appears to be preoccupied or overwhelmed with the day-to-day demands of the regulatory process. Short-term research in support of the regulatory process is necessary, to be sure; but this should not preclude a strong commitment by ORD to long-range research.

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Where long range research is mentioned in the Plan, in most cases the development of techniques is addressed rather than a clear definition of what long-range issues are considered important.

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The knowledge gained from pursuing research on long-range environmental issues is essential to the regulatory and legislative processes.

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ORD's preoccupation with the short-term, prevents it from exercising national scientific leadership and becoming a forum for scientific knowledge reflecting the broadest input from the scientific community and the public.

* * * * *

The report of the Office of Technology Assessment acknowledges the merits of Dr. Talley's contention that, although ORD performs mission-oriented research, as opposed to basic research, providing the best scientific data and anticipating future problems is an integral part of ORD's research program.

Thus, OTA concludes that:

Lack of a well defined commitment to research addressing long-range environmental concerns may reflect the dedication of this Office to its primary job of supporting the regulatory role of EPA. Indeed, ORD was strongly urged to do

this by the Berliner Committee of the National Academy of Sciences, whose principal conclusion was that: "The present Office of Research and Development planning and management system fails to meet the needs of the Agency." This exhortation by the National Academy of Sciences was a key factor in determining the mid-1975 reorganization of ORD.

OTA further notes that:

It could be argued, in addition, that with environmental concerns apparently ebbing in the face of energy and economic problems it is not surprising to find EPA spending its shrinking R&D dollars on supporting its most immediate and direct means of affecting environmental regulation. Moreover, some legislative mandates do require EPA to demonstrate the availability of control technology to meet EPA's environmental standards. The role of the regulatory agency and pressing legislative needs may create an atmosphere unsympathetic to the uncertainties of long-range comprehensive research planning. Therefore, because resources available to ORD are constrained, its natural tendency is to concentrate on well-defined agency requirements and to support regulatory needs as they occur.

Some believe that a viable research program must have both basic and applied research components. Dr. John Tukey testified that:

For the health of our regulatory agencies we should encourage them to do as much research of a rather basic character as they are willing to do. I would like to stress this. Doing this will make them better informed regulators, and thus better regulators.

But it is, I believe, unrealistic to believe that such agencies can be effective in meeting a basic research responsibility—or in meeting a broader responsibility that includes basic overwhelming problems they either ought already to have met or must meet in a year or two.

They can hardly give adequate attention to possibilities which, if found real by difficult research, would alter their whole regulatory stance in some area.

This aspect of the case for separating basic research responsibility from regulation is a very close parallel to the main reason for separating regulation from promotion.

I believe these questions and difficulties are very real—and very important. I would hesitate long before overriding them. But what if Congress, in view of broader considerations, were to decide to place certain broad research responsibilities in some regulatory agency? What could be done to minimize the effect of these difficulties?

As much as possible should be done to reduce coupling between the main functions of the regulatory agency and its broad research responsibilities. The separation of these responsibilities should be made clear in the agency's organic authority.

The separation should be clearly reflected in the agency's administrative organization, with the administrator responsible for these broader responsibilities reporting directly to the head of the agency.

Budgetary submissions and budgetary defense should be as separate as possible. A strong and effective outside advisory committee, something desirable in non-regulatory agencies as well, should exist, function effectively, and have the right and duty of direct reporting to the President and Congress on those occasions when this is necessary. All these things would ameliorate the difficulties; they would not, however, eliminate them.

Such a partial solution might be dictated by other considerations, but it should not be thought of as more than second or third best in getting the broad research responsibility handled.

Dr. Gordon MacDonald believes, however, that a new organizational structure is needed to assure that basic research is adequately supported:

In view of the diverse requirements between long-term and short-term research, I would suggest the following broad framework. The short-term activities should be conducted within the civil service laboratories with great attention to the strengthening of the leadership and assuring that the participants in research feel that they are an essential part of the overall EPA program.

The research on the longer term problems requires an approach vastly different. The longer term research programs such as the epidemiology of air pollutants, the impacts of PCB's on man, and the effects of nitrogen-based fertilizer on the ozone layer, cannot be completely divorced from the ongoing day-to-day operations of the Agency.

But to be successful, these efforts must be provided with the stability and resources that will permit the very best scientists to commit themselves for several years to research in these largely neglected fields.

In considering the alternatives, one could organize a program of grants and contracts with existing institutions, including universities carrying out these longer term programs.

Such a policy would insure that some of the best scientists in the country would be involved.

However, universities and related institutions have a variety of missions, not necessarily compatible with the long-range stability required if we are going to anticipate problems before they overwhelm us.

I believe the importance of longer term environmental research is of such magnitude that a new institutional mechanism with a high degree of visibility is required.

In particular, I would argue that an Environmental Science Institution should be established to carry out the longer term research activities supporting EPA. The new institution should be modeled along those institutes now constituting the National Institutes of Health.

Such an organization could attract the very best talents. Further, the combination of high visibility and adequate resources would encourage the younger and most creative scientists to become involved in the difficult and at present unrewarding task of assessing future environmental problems and developing ways of dealing with them.

I recognize in making this recommendation the difficulties of creating new organizations. However, the success of environmental management requires taking unusual measures.

During his testimony on the costs and effects of chronic exposure to low level pollutants in the environment on November 7, 1975, Prof. Lester B. Lave of Carnegie-Mellon University stated he would place the responsibility for longer-term environmental research in another existing Government agency, viz. the National Science Foundation.

EPA's task is a difficult one, being performed under what are impossible time constraints. It is not likely that responsible EPA officials are going to find the time and money to commission research with an horizon of more than one year. Thus, I would advocate that the Congress appropriate funds for longer term environmental research and that these funds be overseen by the NSF rather than EPA.

My comments should not be interpreted to mean that all research funds should be taken from EPA. Indeed, the great bulk of research funds should remain there, since most of the tasks confronted by EPA require short-term research. Advocating that some funds go to NSF is a way of attempting to insure that these funds will be allocated for research with a longer time perspective than that of the funds administered by the EPA.

RESEARCH PROGRAM EMPHASIS

One of the more pressing questions is the overall balance of the EPA research program. Historically, EPA has emphasized research and development of control technology—hardware and techniques designed for the abatement of pollution of air and water due to the activities of industry and the utilities. An example is the development and retrofitting of flue gas scrubbers at electric utility power plants.

Research on processes and effects, by contrast, deals with identifying and describing pollutants, understanding and monitoring their production, their transport through media such as air or water, their transformation through chemical reactions, their effects on the health and well-being of humans and other living organisms, and their ultimate fate in the biosphere.

Dr. Talley observes that:

As a regulatory agency, EPA requires credible scientific and engineering information in order to promulgate and enforce standards and regulations. Certainly health and ecological effects data on dose-response relationships of harmful materials in the environment are required to determine tolerable pollutant levels. However, effective and economically feasible control technology must also be assessed, and where necessary, developed and demonstrated to ensure that human health and environmental values are protected. Both the Clean Air and Federal Water Pollution Control Acts require the setting of some emission or effluent standards based primarily on technological and economic considerations. Examples are New Source Performance Standards and Best Practicable Technology Standards. The 1972 amendments to the FWPCA emphasized this approach, and some proposed amendments to the CAA would do the same.

While it seems clear that EPA cannot, and should not, withdraw from further research on control technology, there are those who believe that there should be a shift of emphasis in EPA's research program away from large and expensive demonstration projects to exploratory research.

For example, in its report on EPA's five year research plan, the Office of Technology Assessment notes that,

EPA efforts in the development of control and abatement technologies appear to favor demonstration over exploratory research projects. EPA's efforts in this area need to be planned with due regard for ERDA's specific mandate to develop environmentally sound energy technologies and the efforts of private companies with the capability and economic incentive to continue control technology development. Additionally, because EPA is both regulator and developer, it could be put in the position of promoting its own technology.

Others believe that the time has come for ORD to shift its research emphasis from control technology to processes and effects. In appraising EPA's research budget, Dr. Gordon MacDonald states that:

The distribution of funding leaves very much to be desired. Approximately 60 percent of the funding goes into the Office of Air, Land, and Water Use and the Office of Energy, Minerals and Industry. These offices are primarily concerned with the development of pollution abatement technology.

Much of that work, in my view, should be the responsibility of private industry, and Government participation in this research is not as necessary nor as appropriate as research on such questions as pollution emission, pollutant transfer,

pollutant transformation and pollutant effects, particularly health effects that in so many ways influence the way in which people live.

Currently about 27 percent of the R. & D. budget supports the Office of Health and Ecological Effects. . . .

Resources currently available to EPA are certainly sufficient to carry out a broad and strong program, but they need to be redirected with less emphasis on pollutant abatement technology and greater emphasis on the long-term health and ecological effects. . . .

I would say that much of (control) technology is well in hand today. Developments in the private sector have proceeded quite rapidly. Greater emphasis should now be placed on having the Federal Government look into areas not being dealt with in the private sector—health effects, psychological effects—and emphasizing those as opposed to continuing to conduct research on SO₂ scrubbers. That kind of activity quite properly belongs in industry, and industry, private industry, is doing a great deal.

Dr. John Neuhold concurs with Dr. MacDonald's assessment:

The continued expenditure of funds in EPA R. & D. for the development of control technologies seems to me to be past the stage of usefulness. I think that industry is quite capable of control technology development. They have been given a start in this area. A number of specific industries have been created over the past 10 years in this area, and they are fully capable of developing their technology. I fully agree with Dr. MacDonald that industry, the private sector, can in fact not undertake support of research in such areas as ecological and health effects and are the ones which EPA should be concentrating on.

ORD's Deputy Assistant Administrator for Energy, Minerals, and Industry, Dr. Stephen Gage, perceives some practical problems in looking to industry to pursue control technology research, and he cites the historical record:

The general impression that industry can be left to carry out its research and development for pollution control technology given a regulatory requirement has been a notion that has been tried out now, and we have some experience to draw on.

I think that 5 years ago, before the Clean Air Act Amendments came in and the Federal Water Pollution Control Act was passed that the thesis had not been tested. It has been tested in the last 5 years.

Frankly, the thesis does not hold up.

Industry may or may not have the wherewithal to carry out the pollution control research that it needs. The fundamental point, in order to protect the environment, is not whether industry has the resources to do it, but whether it will in fact carry out the pollution control R. & D.

In too many instances, the industry has not carried this out.

You mentioned one excellent example, of flue gas desulfurization. Most of the investment in flue gas desulfurization R. & D. has been made by the Federal government, and unfortunately at this point we are unable to show that the stack gas scrubbers can operate, can operate reliably, can operate with a minimal amount of secondary environmental impact, and can meet the control requirements that we have for sulfur dioxide across the country.

The Industry's initial position of several years ago was that such scrubbers did not work, they could not make them work, and it was only through pollution control R. & D. carried out by the Office of Research and Development that such scrubbers were made to work within the United States.

The fact that they were working in Japan is really quite another subject, but they were made to work here in the United States, and American industry is now beginning to accept that fact.

The point remains, Mr. Brown, that in many instances when faced with an environmental regulation for emission control, the industry finds it much more cost-effective to litigate than to control, and before they can even control, they have to carry out the research and development.

If the industry does not have the capable technical skills to do that themselves, they must rely on vendors of pollution control equipment, but the vendors of pollution control equipment are not going to carry out that research unless they have some degree of certainty that a market will develop for that research. When the regulations are under litigation, the future is clouded and risk capital will not move in.

What the very small amount of pollution control R. & D. dollars that we have really does is to provide that extra incentive, that carrot, rather than the stick, to try to leave more innovative and more risk taking vendors in industry in moving ahead the state of the art of pollution control technology.

And I just think that the record really should indicate at this point that someone making a statement that industry can do it and therefore, why, let industry do the work in the pollution control area really has to be examined against the record in the last 5 years, where we have had real operating experiences with some fairly stringent sticks and we have had very few carrots at that time.

INTERAGENCY COORDINATION

EPA's research program is currently funded at approximately \$260 million. This represents less than 20 percent of the total annual Federal budget of some \$1.3 billion supporting environmental R. & D. in a dozen or so agencies of the government. Coordination among these various programs to avoid major gaps in the total effort as well as undesirable duplication of effort has been a matter of continuing concern to the Committee on Science and Technology.

Expressions of Congressional intent bearing on the question of coordination of environmental R. & D. also appear in a number of statutes which seem to give primary responsibility to the Administrator of EPA:

FEDERAL WATER POLLUTION CONTROL ACT (P.L. 92-500)

SEC. 104. (a) The Administrator shall establish national programs for the prevention, reduction, and elimination of pollution and as part of such programs shall—

(1) in cooperation with other Federal, State, and local agencies, conduct and promote the coordination and acceleration of, research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of pollution;

(2) encourage, cooperate with, and render technical services to pollution control agencies and other appropriate public or private agencies, institutions, and organizations, and individuals, including the general public, in the conduct of activities referred to in paragraph (1) of this subsection;

CLEAN AIR ACT (P.L. 88-206)

SEC. 103. (a) The Administrator shall establish a national research and development program for the prevention and control of air pollution and as part of such program shall—

(1) conduct and promote the coordination and acceleration of, research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, and control of air pollution;

(b) In carrying out the provisions of the preceding subsection the Administrator is authorized to—

(2) cooperate with other Federal departments and agencies, with air pollution control agencies, with other public and private agencies, institutions, and organizations, and with any industries involved, in the preparation and conduct of such research and other activities;

FEDERAL INSECTICIDE, FUNGICIDE, RODENTICIDE ACT (P.L. 92-516)

SEC. 20. Research and Monitoring.

(a) RESEARCH.—The Administrator shall undertake research, including research by grant or contract with other Federal agencies, universities, or others as may be necessary to carry out the purposes of this Act, and he shall give priority to research to develop biologically integrated alternatives for pest control. The Administrator shall also take care to insure that such research does not duplicate research being undertaken by any other Federal agency.

(b) NATIONAL MONITORING PLAN.—The Administrator shall formulate and periodically revise, in cooperation with other Federal, State, or local agencies, a national plan for monitoring pesticides.

(c) **MONITORING.**—The Administrator shall undertake such monitoring activities, including but not limited to monitoring in air, soil, water, man, plants, and animals, as may be necessary for the implementation of this Act and of the national pesticide monitoring plan. Such activities shall be carried out in cooperation with other Federal, State and local agencies.

SOLID WASTE DISPOSAL ACT (P.L. 89-272)

SEC. 204. (a) The Secretary shall conduct, and encourage, cooperate with, and render financial and other assistance to appropriate public (whether Federal, State, interstate, or local) authorities, agencies, and institutions, private agencies and institutions, and individuals in the conduct of, and promote the coordination of, research, investigations, experiments, training, demonstrations, surveys, and studies relating to—

- (1) any adverse health and welfare effects of the release into the environment of material present in solid waste, and methods to eliminate such effects;
- (2) the operation and financing of solid waste disposal programs;
- (3) the reduction of the amount of such waste and unsalvageable waste materials;
- (4) the development and application of new and improved methods of collecting and disposing of solid waste and processing and recovering materials and energy from solid wastes; and
- (5) the identification of solid waste components and potential materials and energy recoverable from such waste components.

NOISE CONTROL ACT OF 1972 (P.L. 92-574)

SEC. 4. (a) The Congress authorizes and directs that Federal agencies shall, to the fullest extent consistent with their authority under Federal laws administered by them, carry out the programs within their control in such a manner as to further the policy declared in section 2(b).¹

(c)(1) The Administrator shall coordinate the programs of all Federal agencies relating to noise research and noise control. Each Federal agency shall, upon request, furnish to the Administrator such information as he may reasonably require to determine the nature, scope, and results of the noise research and noise control programs of the agency.

According to Dr. Talley,

It was not envisaged that EPA's research arm need do everything itself, rather it needed to be aware what was going on outside the Agency, to coordinate efforts where possible, and to undertake what other research effort was needed to assure that the information needed for Agency decisions was available on a timely basis. It was to be the central point of cognizance for specialized research, relying on the processes of information and funding transfers to make sure that the total research effort would be adequate and well articulated.

I believe this original view was, and remains, correct. We in ORD or even EPA cannot perform all the needed research ourselves. First of all, it is an enormous effort and our funding is limited. Second, and more importantly, others are already doing a major part of it. The challenge is that all these other research activities—Federal, State, industrial, academic—must be pulled together, coordinated and focused on particular EPA problems, in order to meet legislative mandates and time frames.

Dr. Talley has explained how Federal interagency coordination of environmental research is accomplished under present circumstances.

Our interagency contacts fall into three principal categories; formal interagency agreements, which involve about 23 percent of our R&D budget; cooperative programs with other agencies; and coordinating activities. This last category includes membership of our staff on various committees and informal day-to-day working level contact among Federal scientists.

To be more specific, what I have termed formal interagency agreements involves an identification of a major pool of talent and expertise in another Federal agency

¹ Sec. 2(b) states "... purpose of this Act to establish a means for effective coordination of Federal research and activities in noise control..."

which can perform some aspect of environmental research and development more capably or efficiently than we can. This type of cooperation usually involves transfer of funds—sometimes to another agency, sometimes from an other agency to us.

A second avenue of cooperation I have termed cooperative programs. These cooperative programs may include interagency agreements, but also include memorandums of understanding which imply relationships, and even less formal agreements.

A third major avenue of contact with other agencies consists of extensive communication, through formal committees and informal working contact, with other Government scientists and technical program people. Such communication often involves participating in the planning and review of other agencies' programs. This can occur in Washington-based groups, for example, with the various committees of the Federal Council on Science and Technology.

Dr. Talley has testified that he expects interagency coordination of environmental research to improve under the reorganization of his office, since headquarters staff are now specifically assigned this responsibility:

One of the key benefits of this realignment of ORD is the shifting of more detailed program management activities to the field and the resultant freeing of headquarters staff to improve coordination both within EPA and with groups external to the agency. I feel strongly, and I have been on the record in this for at least 3 years, that ORD's resources are but a part of a coordinated overall Federal program. Perhaps the most important ORD headquarters function in this area will be to improve and strengthen communications with related programs in other Federal departments. Such improved linkages provide ORD with information on other agency programs and thus allow ORD to plan a research and development effort which is consonant with and responsive to overall national environmental needs.

The fostering of closer working relationships between ORD and other Federal research and development programs will serve to assure that the resources available for environmental research and development are invested in those operations which can most effectively utilize the resources. This will serve to eliminate unnecessary duplication of effort, exploit specialized expertise where it has developed, highlight important research gaps, and adjust the program to fill these gaps, and assure a balanced, coordinated, and effective national environmental research and development program.

Dr. H. Guyford Stever, Director of the National Science Foundation, has testified that,

Much of the responsibility for coordination of these agency efforts rests with the Federal Council for Science and Technology. Within the Council, which I chair, there are about 10 committees working on specific areas of environmental concern.

He went on to say,

I think it is accurate to say that there is reasonable coordination among the Federal agencies involved in environmental research and development. . . . We get coordinated, and participate in coordination, through the Federal Council on Science and Technology. This is on a technical-scientific basis. . . .

The setting and coordination of national priorities for environmental programs, however, is outside the scope of the council's Charter.

Another level of coordination comes, of course, when all of us go for our budgets. This is a process in which the OMB plays an important role. I have gone on record in front of committees of the House as the impoundment battle between OMB and the Congress has developed over recent years to say that if we did not have an OMB, we would have to invent one.

That is the place where a very sharp look is taken at the overlaps and the gaps in the total budget, and so on.

The arrangement described by Dr. Stever does not seem satisfactory to Dr. Gordon MacDonald. He has testified that:

With respect to the coordination of Government research activities in the environment, I can only conclude that at present there is none. The problem of analyzing the coordination is made difficult by the fact that proposals for research support tend to match the hue of current popular Federal policy. As a result, it is possible to round up impressively large sums which were presumably dedicated to supporting the environmental science programs. For example, an ad hoc Committee on Ecological Research was sponsored by the Council on Environmental Quality and the Federal Council for Science and Technology in December of 1974; it reported that \$182 million was spent in fiscal 1973 in ecological research in various Federal agencies. Of this, the Environmental Protection Agency spent only \$18.4 million with 12 other Government agencies making up the rest. As is indicated by that report and from my own personal observations, these research programs proceed independently of each other with a minimum of communication between the participants.

Because of the importance of environmental science to the maintenance and enhancement of the quality of the environment, I believe some special recognition of the needs of environmental science must be given by the Congress and the executive branch. I would urge legislation that would require the executive branch through the Council on Environmental Quality to prepare an annual report on the total environmental research program of the Federal Government.

The Council on Environmental Quality is in a unique position, residing within the Executive Office of the President, to bring together and analyze this information and to present it in a form useful to decisionmakers in both branches of Government.

Such an overview is completely lacking today. A review would complement the 5-year planning activity of EPA in developing its own research programs and would provide guidance to the various agencies conducting environmental research as they plan for their programs in the future.

* * * * *

I strongly urge the requirement of the executive branch to develop for the Congress an annual report on overall research activities in the environment so that a coherent nonoverlapping program can be reviewed annually.

Dr. Vaun A. Newill, a former Special Assistant for Health Affairs to the Administrator of EPA, shares Dr. MacDonald's feeling that coordination of environmental research in the Federal government leaves much to be desired. He testified as follows:

Some years ago, about late 1971, the Office of Science and Technology and the Council on Environmental Quality convened an ad hoc Committee on Environmental Health Research that dealt with the issue of coordination of environmental health research as well as other issues.

The report was never published though many copies have been widely distributed. Also, parts of this report were incorporated into a President's Science Advisory Committee Panel on Chemicals and Health report that was published in 1973. Both of these reports speak more cogently to some of the problems I have mentioned today than I can, including environmental health coordination.

However, I still want to make a couple of statements regarding coordination. Having recognized the need for environmental health research coordination, the Office of Science and Technology moved to establish a coordination program in the fall of 1972.

With the demise of that Office in January 1973 this effort was tabled. Since then, as far as I am aware, no formal mechanism for the purpose has been developed. There is, of course, the informal mechanism of the Office of Management and Budget review that is active.

However, I wonder what technical expertise is brought to bear to help them with this process. It is my sincere belief that there should be a formal coordination function for environmental health research and that it should be at a level in the Federal Government above the actual agencies involved in the research.

This is difficult because Cabinet-rank persons actually head some of the agencies involved. Even so, perhaps this is a role that can be assigned to or accepted by the about-to-be-reformed Office of Science and Technology.

Everything that supports the environmental health effort supports the regulatory program. What we do not have is any internal coordination. There are large gaps in information. They have to be recognized. There are duplications within these programs. These need to be recognized. In fact, this need for coordination was one of the reasons I referred to the ad hoc committee report on environmental health research done under the aegis of OST and CEQ.

Nor is the Office of Technology Assessment satisfied with the way interagency coordination of environmental R. & D. is pursued. In its appraisal of ORD's five year research plan, OTA concludes that:

The ORD Plan fails to recognize and delineate the actual function of EPA in coordinating Federal environmental programs, including programs related to research and development. Though mention is made that such a role exists, the Plan proposes no method to achieve it. The Executive initiative which created EPA and numerous subsequent legislative acts mandating environmental programs seem clearly to place this responsibility with EPA.

Because there are numerous government agencies conducting environmental research, leadership in determining the environmental research goals and priorities among these agencies is essential; ORD is the logical center for such leadership.

FIVE-YEAR RESEARCH PLAN

Among the perceived weaknesses in the management of EPA's research program was a lack of long-range planning, a probable consequence of ORD's preoccupation with the day-to-day exigencies generated by the Agency's basic regulatory mission. The Subcommittee became convinced that some type of long-range strategy should be developed to guide the research program, and to provide a sense of mission continuity to the research personnel.

As the National Academy of Sciences noted in its report on EPA's Office of Research and Development, "a long-term program designed to meet stated goals is missing, and this is vital for any scientific venture."

For these reasons, the Subcommittee amended the initial (fiscal year 1976) EPA Research and Development authorization bill to include a provision requiring that a comprehensive five-year plan for environmental research, development, and demonstration be transmitted to Congress, and that the plan be appropriately revised annually.

Dr. Emil Mrak, Chancellor Emeritus, University of California at Davis is a member of EPA's Science Advisory Board. Regarding the desirability of a five-year research plan for EPA's Office of Research and Development, Dr. Mrak testified,

I commend the subcommittee for its decision to press EPA for a long-term research plan. Such a plan has been too long in coming and will be a great help to the Agency. . . . I think, however, that two points need to be made here: (1) The elements of any such plan can clearly benefit from input offered by the scientific community. Provision should be made for gathering and incorporating such views; (2) any such plan should not be viewed as inflexible.

I think that it is very important to make a 5-year plan and then come back and look at it. . . .

New information or situations can often create a need for research not before perceived.

Dr. Talley responded quickly to the Congressional intent expressed in Section 5 of the EPA Research and Development Authorization Bill for Fiscal Year 1976 which mandated a five-year research plan, and in December 1975, the first draft of the plan was submitted. Dr. Talley explained that, in this initial effort at a five-year research overview, an effort was being made to raise issues and identify environmental problems and priorities. He added that:

I recognize that this is a first attempt and that as such, suffers from the usual weaknesses or deficiencies that are associated with being a first. In addition to substantive criticisms of the projected research program, I invite your comments and suggestions to improve subsequent versions of this document.

Since ORD's five-year research plan represented a new departure in the Agency's management system in the sense that it was a first attempt to structure EPA's future research program so as to anticipate, to the extent possible, future environmental problems, the Chairman of the full Committee on Science and Technology, Honorable Olin E.

Teague, requested the assistance of the Office of Technology Assessment (OTA) in reviewing the first edition of the plan.

OTA's Executive Summary of its assessment of EPA's five-year research plan noted a number of weaknesses:

Foremost among the shortcomings in the R. & D. Plan is EPA's failure to indicate a commitment to long-range research and, as a corollary, an excessive focus on short-term R. & D. issues related directly to the enforcement and/or achievement of EPA's current regulations. Accordingly, the Plan emphasizes the development and demonstration of control technologies. In many cases, however, the larger problems involve social, economic and institutional patterns which not only impede technical solutions but which require nontechnical approaches. To develop effective overall environmental management strategies will require more systematic and sustained socioeconomic research efforts than those specified in the Plan. An added R. & D. emphasis on long-range environmental concerns and a more responsive role to its line responsibility as coordinator of Federal environmental R. & D. would do much to enhance EPA's effectiveness and credibility.

PERSONNEL PROBLEMS

There are problems in managing a research laboratory under the Civil Service System. As Dr. Talley has testified, a number of constraints, completely outside his control, pose major obstacles:

Our severe limitation is in the area of personnel. The main problem here is not chiefly one of numbers, but rather one of skills and salaries. A low attrition rate, an overall reduction in personnel ceiling, certain inflexibilities in the personnel system, and an inherited skill mix have severely restricted our ability to modify or change the type of activities we undertake in our own laboratories.

Developing and retaining a well-qualified professional staff is difficult for several reasons, according to Dr. Vaun Newill:

Salary levels in the Federal Government for those below the professional level are competitive. At the professional level the salaries tend to be less than top-notch professionals can draw in other quarters.

This does not make the task of building a research organization impossible but means that rewards other than salary have to be important to the individual to accept a Federal job.

Such a limitation tends to make the Government professional staff younger, less experienced, and consist of persons who derive other than economic satisfaction from the job they have.

Dr. Newill further notes the difficulty in altering the mix of disciplines in a laboratory that should accompany a change in program emphasis, particularly when the laboratory is under a no growth or reduction mandate.

With a no growth order and with no empty positions, there can be no shift in the discipline mix. If the order were to reduce staff, as happened on several occasions during my tenure, it usually came with other provisions, for example, no personnel can be fired and the reduction will be by attrition.

Attrition is a very bad way to alter the size of an organization. One, it does not allow the manager to get rid of his nonproductive personnel; two, the most reemployable and thus most desirable employees are the ones who recognize the situation and move out; and three, the manager has no control over the discipline mix within the organization because the all important position count mentioned earlier does not distinguish between professional and non-professional positions.

Finally, a Civil Service laboratory has difficulty hiring research personnel because of rules prescribing the "average grade" of personnel at the installation. According to Dr. Newill:

Quality personnel can only be hired at the higher grade levels and thus a good research organization heavy with professional personnel always will be above the assigned average grade.

During the latter years I was a laboratory manager, the in-house dollars were spent about 75 percent for personnel and 25 percent for maintaining the ongoing research effort. When the order for a 10-percent reduction in budget came, as it frequently did, we were in trouble.

The only place the in-house 10 percent could come from would be the research support budget, thus the money to maintain the research effort was reduced from 25 percent to 15 percent, a 40 percent reduction. The level of operation funding will not keep a viable program underway and guarantees loss of qualified professional research employees.

Rather than destroy the in-house program and lose hard to come by staff, the total dollar reduction was usually taken out of the support for research grants and contracts. This meant a reduction in purchased research. Such a loss was also a bad one.

Hard to come by, and this is really true in the mid to late 1960s, grantees and contractors became disgruntled with our support, lost their knowledgeable supporting staff to do this work, and turned their interests to other areas.

Whether our decision to maintain this in-house effort rather than the extramural one was the best decision was not considered because we had to maintain our tenured employees.

I continue to be amazed that the Government laboratories retain as competent staffs as they do and that they are as productive as they are. Certainly the system under which they work is far from optimum.

FINDINGS AND CONCLUSIONS

The Subcommittee takes cognizance of a number of considerations, some unique to EPA, which have influenced and shaped the organization and management of the Office of Research and Development.

(1) EPA was created from an aggregation of existing agencies with established research components. Each of the several units of Government brought together in 1970 to form EPA had different orientations and institutional biases, different methods of operation, different traditions and customs, and are understood to have been staffed with personnel of uneven skills and talents. As Dr. John Neuhold observed, "The task of molding these into a cohesive and coherent R. & D. division for EPA was not a simple task." In fact, pulling together 42 geographically dispersed research institutions of widely differing character would have challenged the finest management talent.

(2) EPA's regulations frequently involve social and economic considerations that affect large segments of our population. In other words, environmental decision-making is often highly political and subject to intense political pressures. Since environmental standards almost always require balancing of economic considerations, usually in the form of increased costs as against the public health and welfare, the reactions of the public and of interest groups are, and should be, assessed and given appropriate weight.

Perhaps no other regulatory agency has such widespread and intimate impact on the individual lives of citizens, and on modern American society in general. Business and industry understandably resist any regulation of their activities which may require changes in established methods of production and distribution. Such changes can be expensive and inconvenient.

With powerful economic interests arrayed against change, EPA has found it cannot rely upon presumptions or inferences of risk to the public health or welfare. The Agency must have scientific facts to support defensible standards, since the burden of proof rests with those proposing change. They are required to produce persuasive evidence—sometimes conclusive evidence—that proposed new regulations are indeed needed in the interest of the public health and welfare.

To the extent that scientific evidence can remove uncertainties, resistance to proposed environmental standards can be overcome. Such evidence is generated by EPA's Office of Research and Development. Thus, the purpose of EPA's research program is to remove uncertainty. For this reason, the work of ORD is crucial to the adoption of rational public policy. The success of EPA depends upon the extent to which the Agency's standards and regulations are based upon sound scientific analyses.

The more we learn about the social and economic consequences of environmental pollution, the greater is our realization of the truly staggering costs to our society, both in terms of adverse effects upon

human health and upon the ecology in general. Our knowledge and understanding of these costs are based upon the results of research, and the Subcommittee concludes that the nation's investment in such research does not reflect its true potential economic value.

Given EPA's enormous statutory responsibilities for pollution control and abatement, the Subcommittee concludes that ORD's program has not been adequately funded. Resources requested by the Administration for support of EPA's research program historically have fallen far short of funding levels authorized by the Congress. The Subcommittee believes that the annual budget for support of ORD's program should be substantially increased in the future.

(3) The original organization and management of the Office of Research and Development, as noted elsewhere in this report, left much to be desired. The changes brought about by Dr. Talley's reorganization appear to be responsive to the major criticisms of the past, and seem well conceived to achieve a more efficient, more responsive, more effective research program. Major improvements have been accomplished in simplifying the lines of authority and responsibility, eliminating undesirable layers of management, and replacing the earlier paper-intensive planning and management system with a more streamlined organizational framework.

While some dislocations and morale problems are inevitable in any major reorganization, and this one is no exception, the impacts upon ORD personnel appear to the Subcommittee to have been reduced to a reasonable minimum and reflect a thoughtful and considerate approach on the part of Dr. Talley.

The Subcommittee takes the position that Dr. Talley's reorganization should be allowed a chance to work. Thus, while the Committee finds Dr. MacDonald's recommendation for establishment of a new Environmental Science Institute attractive, and acknowledges that it may well be the best course for the future, serious consideration of such a proposal should be postponed. Another major reorganization would be extremely disruptive to an Agency that is still in the process of making a difficult adjustment to new circumstances. Moreover, as a practical matter, the current economic and political climate does not appear congenial to the establishment of a new research institution regardless of the merits of the proposal.

Finally, for the same reasons, suggestions to the effect that the research function might be separated from EPA's regulatory and enforcement mission, following the ERDA-NRC and NIOSH-OSHA precedents, do not appear realistic or timely. While the Subcommittee acknowledges there may be certain advantages in the separation of research from regulation, a strong case can also be made for having a research arm responsive to, and under the direct supervision of, the head of an agency charged with a specific mission. In short, there may be no "ideal" management model for research, and various modes can be made to work efficiently and effectively. Dr. Talley's new organization should be given a reasonable opportunity to demonstrate its effectiveness.

(4) EPA carries out its mission under the legislative mandates of nine statutes. These acts of Congress, products of several different Committees of both Houses, passed at different times and under different historical influences, form the major basis for, and constraints on, the research program.

Accordingly, the legislative basis for EPA's program lacks internal consistency. In response to the various acts of Congress, EPA management has focused on separate media, such as air and water, and on specific environmental threats, such as noise, solid waste, pesticides, etc. Dr. Gordon MacDonald observes that,

These legislated bits and pieces are in direct opposition to the holistic view which is essential to effective environmental management. . . . The programs and organization of EPA, derived from an incoherent set of pollution control legislation, runs counter to the comprehensive systems view of the environment in virtually every instance.

The National Academy of Sciences report also noted that, "Enabling legislation is noncoherent and mandates a set of unbalanced and uncoordinated research objectives and timetables."

The Subcommittee acknowledges this unfortunate fragmentation of legislative authority. The solution to the problem, however, is not readily apparent. As a step in the right direction, an attempt has been made by the Committee on Science and Technology to establish a procedure for regular, comprehensive review of the accomplishments, programs, and plans of the Office of Research and Development through the annual authorization process. Structuring the ORD annual budget, the annual authorization legislation and the annual appropriation legislation to conform to the present organizational structure of ORD might also be useful.

(5) Considering the timetables and other constraints imposed by existing legislation, as well as the limited funding available to support its research programs, ORD has found it difficult to mount a sustained long-term basic research effort. This is especially so in light of Dr. Talley's view of the mission of ORD as one of applied research in support of the work of the Agency's regulatory and enforcement offices.

Since the Subcommittee perceives a need for more fundamental research on environmental matters—patient, uninterrupted, long-term research characterized by continuity and stable funding—the new institutional entity proposed by Dr. MacDonald is attractive and may some day be required. Establishment of an Environmental Science Institute modeled after the National Institutes of Health might be exactly the right course to assure that basic research is adequately supported in the future. This would also leave EPA's Office of Research and Development free to provide the technical support and quick-reaction research needed by other components in the Agency, the very role envisioned for ORD by Dr. Talley.

In the meantime, since the Subcommittee believes that a viable environmental research program should have both basic and applied research components, the Subcommittee suggests further initiative by Dr. Talley toward earmarking a certain portion of the ORD budget for support of a basic research effort, either in-house or by long-term grants or contracts, and insulating such basic research from the pressures and demands of the regulatory and enforcement functions of the agency.

(6) The Subcommittee acknowledges that from the beginning EPA was under great pressure by Congress, particularly under the Clean Air and Federal Water Pollution Control Acts, to undertake development of pollution control and abatement technology. Modern industrial man had gotten a head start in polluting the air, land, and water,

and EPA was expected to make heroic efforts to reverse the destructive trend, and to restore the environment. Under difficult circumstances marked by strong resistance from powerful economic interests, EPA has made impressive strides in bringing about a steady improvement in the quality of the nation's environment.

The time may have arrived, however, when ORD's research and development of control technology, and particularly the larger demonstration projects, should be given somewhat less emphasis in the total program. In light of expanded efforts by industry and by the Energy Research and Development Administration, the Subcommittee would prefer, during the next few years, to see a larger and increasing portion of ORD's resources devoted to research on pollution processes, their transport, their transformation, and their health and ecological effects.

While much remains to be done in control technology, much more needs to be done to understand the processes by which pollutants are produced and enter the various media, what happens to them, and how they affect human health and the ecology generally. A more comprehensive understanding of environmental conditions and trends is essential to support EPA's future decision-making process, and this research effort should be steadily increased.

(7) Interagency coordination of environmental research and development activities continues to be a matter of concern to the Subcommittee. The present system is considered inadequate to achieve an integrated and coherent national program from the various elements dispersed among the dozen or so mission-oriented Federal agencies engaged in environmental R. & D. Without intending to disparage the work of the various Committees of the Federal Council for Science and Technology which address the technical aspects of environmental R. & D. but have no management responsibilities, or the contributions of the Office of Management and Budget which is responsible for allocation of resources, the Subcommittee believes some other method or vehicle must be brought into play in order to avoid undesirable duplication of effort as well as major gaps in the total research program. At the very least, a continuing inventory of on-going environmental research and development programs should be kept so that the details of research being conducted elsewhere within the Federal establishment would be readily available to all interested parties. In addition, an immediate effort should be made at the highest level, preferably by the newly established Science Advisor to the President, or by the Council on Environmental Quality, to establish clearly defined agency roles and goals for achieving a well-coordinated total national environmental R. & D. program.

EPA was established to bring together much of the environmental work in the Federal government. According to Dr. Talley, Reorganization Plan No. 3 of 1970 envisioned EPA not as an agency which would perform all environmental research, but one which would insure that all necessary research would be done. Dr. Talley concludes that "close cooperation with other agencies is not only desirable, it is mandatory."

Furthermore, the several statutes under which ORD conducts its research program, noted elsewhere in this report, give EPA a special responsibility for coordinating environmental research throughout the Federal Government.

The Subcommittee concurs with Dr. Talley's view that EPA's responsibility "should stop short of any type of direct supervision of the other agency programs since they have their own legislative mandates and consequently must necessarily operate with different priorities." Nevertheless, the Subcommittee would welcome a new initiative to promote more effective interagency coordination of environmental R. & D., and agrees with the view expressed by the Office of Technology Assessment to the effect that "leadership in determining the environmental research goals and priorities among these agencies is essential; ORD is the logical center for such leadership."

(8) The Subcommittee commends Dr. Talley for a good faith effort to initiate long-range planning for the Office of Research and Development, an important element that had been missing in EPA's research program. We believe that the initial five-year research plan can and will be substantially improved as it undergoes further review and analysis in the annual up-dating process. We recommend that the plan be subjected to additional critical review, similar to that provided by O.T.A., using EPA's own Science Advisory Board and other competent outside scientific consultants.

(9) The Office of Research and Development carries out its work using in-house staff, by awarding grants and contracts, and through interagency agreements. EPA's research laboratories are Government owned and operated. A competent in-house staff is needed both to perform research and to evaluate that which is done under grant or contract.

There are certain advantages to Civil Service laboratories compared to contractor-operated laboratories, according to Dr. H. Guyford Stever, Director of the National Science Foundation. He believes Civil Service laboratories provide

Better control over the nature and quality of the work force and of the work performed, over the stability and continuity of the work force and the work performed, over the relevance of the work to the missions of the agency, and to some extent over costs. These are particularly advantageous for long-term continuing programs not subject to rapidly changing work loads or program priorities.

Unfortunately, EPA's research effort cannot fairly be described as a long-term continuing program not subject to rapidly changing work loads or program priorities. On the contrary, Dr. Talley views ORD's primary mission as support of the regulatory and enforcement functions of the Agency. The exigencies of regulation and enforcement are such that priorities change rapidly and the continuity of research is frequently disrupted, thus giving rise to the "pollutant of the month" syndrome which characterizes much of ORD's research.

Civil Service rules also impose certain constraints which affect the ability of EPA laboratory directors to acquire and retain competent personnel. For example, Civil Service salaries at the professional level have been described as non-competitive, especially for highly trained personnel in short supply such as medical doctors.

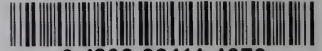
Under some circumstances, Civil Service rules prescribing "average grade" and rewarding administrative responsibility more generously than scientific work make it particularly difficult to recruit and maintain an appropriate mix of skills and talents, and to adjust an existing

mix of scientific and technical disciplines to a change in program emphasis brought about by new circumstances or new responsibilities. Career civil servants are afforded certain protections such as "bumping rights," which preclude flexibility in hiring and firing personnel of the type that exists in contractor-operated laboratories. Attrition is often relied upon to reduce the size of the Civil Service organization, which results, in the view of some observers, in the retention of the least productive personnel, and provides no control over the mix of disciplines.

In short, EPA's Civil Service laboratory system presents ORD's top management with a number of constraints which give rise to problems made more difficult by the "no growth" situation caused by stringent personnel ceilings imposed upon ORD by the Office of Management and Budget during much of ORD's existence.



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